



Environment and Natural Resources Trust Fund

2022 Request for Proposal

General Information

Proposal ID: 2022-086

Proposal Title: Can we turn our cities' green lakes blue?

Project Manager Information

Name: Lawrence Baker

Organization: U of MN - College of Food, Agricultural and Natural Resource Sciences

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Project Basic Information

Project Summary: This project seeks to find new ways to reduce impairment of Minnesota's urban lakes in ways that are more effective and less expensive, moving upstream to the source of pollution.

Funds Requested: \$632,000

Proposed Project Completion: June 30 2025

LCCMR Funding Category: Water Resources (B)

Project Location

What is the best scale for describing where your work will take place?

Statewide

What is the best scale to describe the area impacted by your work?

Statewide

When will the work impact occur?

During the Project and In the Future

Narrative

Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.

Half of all Minnesotans live within a mile of a city (urban) lake. These lakes provide important cultural, aesthetic, and recreational benefits and are often iconic fixtures in a city's landscape. Urban lakes are often the lakes most used by citizens because they are close to home. The problem to be addressed is that too many of these lakes are green, not blue. Throughout Minnesota, 188 urban lakes have been designated "impaired" by nutrients and chloride, meaning they don't provide these benefits; reduced clarity also reduces shoreline property values. These impaired lakes are located in nearly every legislative district in the state (see graphic). Decades of effort to improve urban water quality have "restored" very few lakes. This is the opportune time to evaluate our progress toward improving water quality and modernize our strategies because 1) the two major programs (Impaired Lakes and Stormwater Management) are now 20 years old, and 2) during this time, we now compiled reams of data on water quality and in-lake lake restoration practices (such as carp removal alum), developed fine-scale land cover & topography maps; and built thousands of stormwater best management practices (like ponds and infiltration basins).

What is your proposed solution to the problem or opportunity discussed above? i.e. What are you seeking funding to do? You will be asked to expand on this in Activities and Milestones.

Our goal is to develop management approaches to restore the large number of impaired urban lakes that remain impaired, as cost-effectively as possible. To solve this problem, we will do three things. (1) We will examine how changes in human activities in watersheds have affected lake water quality. (2) Using findings from (1), we will examine time trends of water quality over 10-20 years to determine what changes in watershed characteristics (including urban climate) have either improved, degraded, or had no effect on water quality. This will include both active changes (e.g., stormwater management or the lawn P ban) and passive changes (such as increased impervious surface). We anticipate this step will lead to "upstream solutions" (like improved erosion control, enhanced street sweeping) that have often not been widely implemented but may be more effective and cheaper than current practices. (3) We will evaluate the effectiveness of common "in-lake" restoration methods, and develop guidelines to evaluate when these practices can be effective and cost efficient.

What are the specific project outcomes as they relate to the public purpose of protection, conservation, preservation, and enhancement of the state's natural resources?

The major outcome will be the development of ways to make lake restoration efforts more effective and cheaper. We will 1) develop an understanding of why lakes experience either large improvements or continued degradation over time 2) develop an approach to estimate the responsiveness of individual lakes to restoration efforts; 3) quantify water quality "lag times" (the time between implementation of a practice and water quality improvement), 3) develop protocols to evaluate watershed source reduction efforts, and 4) evaluate widely-used in-lake restoration practices.. These outcomes will be integrated into an outreach manual for urban waters.

Activities and Milestones

Activity 1: Determine active and passive causes of water quality changes in urban lakes.

Activity Budget: \$316,000

Activity Description:

This activity will examine several decades of lake and watershed data to understand what causes changes in water quality of urban lakes. Data sources will include Met Council, watershed districts, MPCA, DNR, USGS, LCCMR study outcomes, and the Citizens Lake Monitoring Program. Types of data include: 1) lake data (nutrients, algae, and clarity), 2) stormwater and stream data (nutrients, suspended solids, etc.), 3) lake and watershed morphometric data, 4) watershed cover and land use, and 6) long-term weather patterns. We will also analyze changes in water quality regulations and the implementation of stormwater practices, and land cover/land on the same time frame. These data will then be used to understand what external factors have the greatest influence on lake water quality using both well-established techniques (like statistical trend analysis) and advanced techniques (such as machine learning). We anticipate that changes in lake water quality occur both as result of "passive" changes (such as changes in watershed land cover) and "active" management, such as stormwater management and in-lake restoration practices, both influenced by "lag times" resulting from slow release of nutrients that was previously stored in soils.

Activity Milestones:

Description	Completion Date
Compilation of data into master archival database	June 30 2023
Interpretative report on causes of water quality change in urban lakes	June 30 2024
Visualization dashboard to display key findings	June 30 2024

Activity 2: New approaches to turn lakes blue

Activity Budget: \$316,000

Activity Description:

Findings from activity 1 will be used to ask: can we improve urban lake restoration, turning more green lakes blue? Here we will evaluate the effectiveness of specific watershed practices, to include an evaluation of past practices (have they worked or not worked, and why?), and a focus on new upstream source reduction practices. For in-lake practices, we will have a focus on improving outcome predictions of success. In this activity we will also communicate findings to the water quality community and the public. These findings will form the basis of a summary report on the linkage between lakes and watersheds (Milestone 1), several status-update presentations at the Minnesota Water Resources Conference (Milestone 2), an outreach manual on in-lake restoration approaches (Milestone 3), an outreach manual on watershed-based lake restoration approaches (Milestone 4), and several easy-to-use Excel "calculator tools" to evaluate the effect of several common management practices. Near the end of the project, we will make a professional-level video on new directions in water quality management (Milestone 5) and hold a workshop (budgeted for about 100 attendees) to present findings to watershed professionals and interested citizens (Milestone 6).

Activity Milestones:

Description	Completion Date
Report on linkage between lakes and watersheds in lake restoration	June 30 2024
Presentation of project findings to Water Resources Conference	October 31 2024
Final workshop to summarize project outcomes	May 31 2025
Outreach manual on in-lake management practices	June 30 2025
Outreach manual on watershed-based lake restoration approaches	June 30 2025
Several Excel-based tools to evaluate the effect of management practices	June 30 2025

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Lawrence Baker	University of Minnesota	Dr. Baker will provide overall project management and the budget. He will lead the Technical Advisory Group. He will also work directly on the interpretation of lake & stream water quality trends, the develop of planning models for source reduction solutions and the synthesis evaluation of past in-lake restoration efforts.	Yes
Dr. John Nieber	University of Minnesota	Dr. John Nieber will lead the hydrologic analysis, including mapping of source areas of pollutants (nutrients, chloride, and suspended solids) and interpretation of seasonal change. He will also lead the "trend analyses", using both conventional trend statistics and newer "machine learning" tools. He will also contribute to all publications.	No
Dr. Jacques Finlay	University of Minnesota	Finlay will help to understand why water quality in urban lakes either improves or gets worse, and and understand how these changes are related to land use change (e.g. suburbanization), direct management interventions (e.g. alum treatment, BMPs), carp management, lag effects, and urban warming.	Yes
Dr. John Chapman	University of Minnesota	Dr. Chapman will lead the outreach activities, including development and management of the final project workshop and the training video. He will also provide expertise in erosion, including lake erosion processes and urban erosion control and water quality management, and will provide expertise in engineered stormwater treatment systems.	Yes
Kate Carlson	University of Minnesota, USpatial	Kate Carlson will compile disparate databases and metadata into a project master database, develop a Data Dashboard for communication with water managers and the public, and develop visualization products.	No

Long-Term Implementation and Funding

Describe how the results will be implemented and how any ongoing effort will be funded. If not already addressed as part of the project, how will findings, results, and products developed be implemented after project completion? If additional work is needed, how will this be funded?

We will develop a Technical Advisory Group (TAG) composed of water quality managers from state agencies, watershed districts, and cities to shape the research so that products lead to implementation on the ground (letters of support are attached) . Possible enhancement of our LCCMR effort may occur if 2 proposals on "machine learning" (both involving J. Nieber) that are now being reviewed are funded. Any gaps in knowledge of water quality management that we discover in 3 years may guide research questions to be answered in a new Minneapolis-St. Paul (MSP) Metropolitan Long-Term Ecological Research Project.

Project Manager and Organization Qualifications

Project Manager Name: Lawrence Baker

Job Title: Research Professor

Provide description of the project manager's qualifications to manage the proposed project.

My research focuses on water quality problems in cities and farmland, generally with the purpose of finding solutions to water quality problems that are more effective and less expensive than conventional approaches. For example, in related research we showed that enhanced street sweeping along tree-lined streets was a very effective way to remove nutrients at far lower cost than conventional "downstream" structures, such as stormwater ponds. MPCA is currently developing guidelines for cities to receive credit for street sweeping based on the procedures we developed. Other related projects include 1) an analysis of lakeshore development on water quality (lakes in the Brainard and Alexandria areas), 2) the development of adaptive management strategies to enable Edina to reduce road salt use and another to

guide the reduction of tastes and odor problems in Phoenix's water supply, 3) several studies to characterize stormwater runoff, 4) the development of models to predict algae levels in Florida lakes. Many of my projects have had practical outcomes for water managers. In addition to the development of adaptive management strategies (above), these include spreadsheet tools, training manuals, workshops, and videos; articles in professional magazines; numerous talks for watershed districts, cities, and environmental organizations; and occasional newspaper columns. I've also published about 120 journal articles, book chapters, and peer-reviewed reports, plus edited books (including *The Water Environment of Cities*).

I have always completed projects within budget, and nearly always within the proposed time frame, with a few exceptions due to mitigating circumstances (like Covid), and then only with prior approval of the sponsors.

I have worked closely with my co-principal investigators (Dr. John Nieber, Dr. John Chapman, and Dr. Jacque Finlay) of this proposal on several previous projects, several of which used the same databases we are proposing to use on the proposed project.

Organization: U of MN - College of Food, Agricultural and Natural Resource Sciences

Organization Description:

CFANS (College of Forestry, Agriculture, and Natural Resources) includes 12 academic departments and 10 research and outreach centers make up our college, along with the Minnesota Landscape Arboretum, the Bell Museum, and dozens of interdisciplinary centers. Our department (co-PIs Baker, Nieber, and Chapman) includes a major research, education, and outreach thrust on land and water resources, including foci in urban stormwater management, lake management, erosion management.

More broadly, the University of Minnesota is one of the top two U.S. universities in water-related research. The U of M teaches 195 water-related courses and 274 researchers are involved in water research. Much of this work focuses on management, watersheds, ecology and water quality.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Lead PI		Project lead, research, supervision, analysis - currently .25 FTE			36.5%	0.51		\$91,296
Co-PI Finlay		Supervision, Research, Analysis - Summer salary only			36.5%	0.24		\$49,077
Co-PI Chapman		Supervision, Research, Analysis - contract faculty			36.5%	0.24		\$38,941
Co-PI Carlson		Supervision, outreach, data analysis			36.5%	0.51	X	\$44,216
1 Post Doc Research Specialist		Research			25.4%	3		\$191,887
1 Graduate Student		research			45%	1.5		\$150,951
3-4 Undergrad students		Research assistance - 1000 hrs per academic year (390 per year max/student)			0%	1.5		\$34,827
							Sub Total	\$601,195
Contracts and Services								
Professional videographer TBD	Professional or Technical Service Contract	Storyboard, film, edit video for dissemination to public, particularly those without relevant scientific knowledge.				-		\$10,000
							Sub Total	\$10,000
Equipment, Tools, and Supplies								
	Tools and Supplies	Database management system such as Tableau	collection and synthesis of data across project, output for communication					\$5,000
	Tools and Supplies	software license	support analysis of data across three year, multiple users					\$4,000
							Sub Total	\$9,000
Capital Expenditures								

							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Conference Registration Miles/ Meals/ Lodging	3 people to Mn Water Resources conference @ \$250 each	registration					\$750
	Miles/ Meals/ Lodging	mileage to sites to including 5 1 day trips to visit out-of-metro cities that have impaired lakes to acquire information; limited travel to specific lakes to get on-the-ground views.	mileage at .56/mile = approx. 5,267 miles					\$3,055
							Sub Total	\$3,805
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
	Publication	Public access fees for three journal articles	dissemination of information					\$6,000
	Publication	Editorial support for final report	advanced presentation software skills for user friendly dissemination of information					\$2,000
							Sub Total	\$8,000
Other Expenses								
							Sub Total	-
							Grand Total	\$632,000

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Personnel - Co-PI Carlson		Supervision, outreach, data analysis	Classified : Kate Carlson is a highly specialized professional within the UM department of Spatial Imaging. Her earnings will be used to engage a graduate student to assist her in working on this project.

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
			State Sub Total	-
Non-State				
			Non State Sub Total	-
			Funds Total	-

Attachments

Required Attachments

Visual Component

File: [316540f6-b09.pdf](#)

Alternate Text for Visual Component

The map shows the number of nutrient -and chloride-impaired urban lakes in each legislative district throughout Minnesota. Nearly every district includes one or more impaired lakes....

Optional Attachments

Support Letter or Other

Title	File
Crow Wing County support	83c009ee-186.pdf
SPA letter	867972ff-1d4.pdf
Letter from Jessica VanderWerf, Edina	66577e10-7c0.docx
Letter from Jay Riggs, Washington SWCC	1af2bf48-ec2.pdf
letter from MCSC	7e794c90-8fc.pdf
Letter from MWMO	dfe409ed-f51.pdf
Letter from Freshwater Society	cae8664f-9e3.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Does your project have potential for royalties, copyrights, patents, or sale of products and assets?

No

Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?

N/A

Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?

N/A

Does your project include original, hypothesis-driven research?

Yes

Does the organization have a fiscal agent for this project?

No

2018 Impaired Lakes - Nutrient and/or Chloride

Lakes near cities with populations greater than 5,000
by Legislative Districts

